

Digital Design 5th edition
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CH1 Digital systems & Binary Numbers

1.1 →

1.2 Binary Numbers

$$7392 = 7000 + 300 + 90 + 2$$

$$\rightarrow = 7 \times 10^3 + 3 \times 10^2 + 9 \times 10^1 + 2 \times 10^0 \quad \leftarrow$$

0 → 9

المقادير من القوة العظمى

0 → 9	0 → 9	0 → 9
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$$(26.75)_{10} = 20 + 6 + 0.7 + 0.05 \quad a_{-2} \cdot r^{-2}$$

$$= 2 \times 10^1 + 6 \times 10^0 + 7 \times 10^{-1} + 5 \times 10^{-2} \quad \leftarrow$$

$$a_n \cdot r^n + a_{n-1} \cdot r^{n-1} + \dots + a_2 \cdot r^2 + a_1 \cdot r^1 + a_0$$

$$+ a_{-1} \cdot r^{-1} + a_{-2} \cdot r^{-2} + \dots + a_{-m} \cdot r^{-m} \quad \rightarrow \text{radix} \equiv \text{base}$$

$$10 = r \quad a_1 = 2 \quad a_0 = 6 \quad a_{-1} = 7 \quad a_{-2} = 5$$

$$(26.75)_{10} = (11010.11)_2$$

$$(11010.11)_2 = a_4 \cdot r^4 + a_3 \cdot r^3 + a_2 \cdot r^2 + a_1 \cdot r^1 + a_0 + a_{-1} \cdot r^{-1} + a_{-2} \cdot r^{-2}$$

$$\begin{matrix} a_4 & a_3 & a_2 & a_1 & a_0 & a_{-1} & a_{-2} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \end{matrix}$$

$$= 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 + 1 \times 2^{-1} + 1 \times 2^{-2}$$

$$\downarrow = (26.75)_{10}$$

$$r = 2$$

$$(4021.2)_5 = 4 \times 5^3 + 0 \times 5^2 + 2 \times 5^1 + 1 \times 5^0 + 2 \times 5^{-1}$$

$$\begin{matrix} a & a & a & a & a_{-1} \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow \end{matrix}$$

$$8 = 5 = (511.4)_{10}$$

$$(127.4)_8 = 1 \times 8^2 + 2 \times 8^1 + 7 + 4 \times 8^{-1} = (87.5)_{10}$$

base = 10 (0 → 9) (A → 10)

base = 5 (0 1 2 3 4)

base = 8 (0 → 7)

base = 16 (0 → 9) (10 → 16)

[A = 10 B = 11 C = 12
D = 13 E = 14 F = 15] (A → F)

base = 16 0 → 9, A → F

$$(B65F)_{16} = 11 \times 16^3 + 6 \times 16^2 + 5 \times 16^1 + 15 \times 16^0 = (46687)_{10}$$

addresses instructions → 11101011 11011011
ASCII

$$(B65F)_{16} = (1101011001011111)_2$$

↑ 4 ↑
↓ 16 ↑ ↑
↓ 16 ↑ ↑

→ 2 ¹⁰ = 1K = 1024	↓	1T = 1024G	2 ¹⁰ = 1K
→ 2 ²⁰ = 1M		1G = 1024M	→ 2 ¹¹ = 2K
2 ³⁰ = 1G		1M = 1024K	→ 2 ¹⁵ = 32K
2 ⁴⁰ = 1T		1K = 1024	→ 2 ¹⁸ = 262144

Table 1.1
Powers of Two

n	2 ⁿ	n	2 ⁿ	n	2 ⁿ
0	1	8	256	16	65,536
1	2	9	512	17	131,072
2	4	10	1,024 (1K)	18	262,144
3	8	11	2,048	19	524,288
4	16	12	4,096 (4K)	20	1,048,576 (1M)
5	32	13	8,192	21	2,097,152
6	64	14	16,384	22	4,194,304
7	128	15	32,768	23	8,388,608

$$2 = 89$$

2⁵

2ⁿ

$$(110101)_2 = 32 + 16 + 4 + 1 = (53)_{10}$$

32 16 8 4 2 1
↓ ↓ ↓ ↓ ↓
2⁵ 2⁴ 2³ 2² 2¹ 2⁰

$$\begin{array}{r} 101101 \\ + 100111 \\ \hline \end{array} \quad \begin{array}{r} 45 \\ + 39 \\ \hline \end{array} \quad \begin{array}{r} 84 \end{array}$$

$$(1010100)_2 = 64 + 16 + 4 = (84)_{10}$$

64 32 16 8 4 2 1
↓ ↓ ↓ ↓ ↓ ↓
2⁶ 2⁵ 2⁴ 2³ 2² 2¹ 2⁰

1010100
0010100
1000000
11 = 1 + 1 + 1

$$\begin{array}{r} 101101 \\ - 100111 \\ \hline \end{array} \quad \begin{array}{r} 000110 \end{array}$$

$$(110)_2 = 4 + 2 = (6)_{10}$$

$$\begin{array}{r} 15 \\ - 9 \\ \hline \end{array} \quad \begin{array}{r} 6 \end{array}$$

QUESTION 1: Convert 10111011 to decimal

$$\begin{array}{r} 1011 \\ \times 1011 \\ \hline 1011 \\ 0000 \\ 1011 \\ \hline 1101111 \end{array}$$

$(1101111)_2$

$$\begin{array}{ccccccc} 32 & 16 & 8 & 4 & 2 & 1 & \\ (1101111)_2 & = & 32 & + & 16 & + & 4 & + & 2 & + & 1 & = & (55)_{10} \\ & & \underbrace{\hspace{1.5cm}} & & \underbrace{\hspace{1.5cm}} & & & & & & & & \\ & & 52 & & 3 & & & & & & & & \end{array}$$

$$\begin{array}{r} 11 \\ \times 5 \\ \hline (55)_{10} \end{array}$$

95%

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